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ABSTRACT

This study traces the introduction of microcomputers in two elementary schools, one middle school, and one high school in San Diego County, California. To determine whether or not the process of introducing microcomputers in education includes the necessary elements for change outlined by S. Saranson--i.e., a positive concept of the change, involvement of those affected, and the development of constituencies--four teachers from each school were interviewed and observed in their classrooms to collect data on their training on microcomputers, their attitudes about microcomputers in the schools, their strategies for integrating computers into their classrooms, and conflicts engendered at all levels of the school system. In general, the study revealed a positive attitude on the part of teachers, principals, district administrators, and groups outside the schools toward the introduction of computers. Educators throughout the school system have been involved in this innovation. Teachers themselves have set goals and discussed implementation strategies with other teachers, principals, school district administrators, and business professionals. Constituencies have been developed as a means of survival in the coming years. Since all three of Sarason's conditions have been met in the schools in this study (resulting in a grassroots rather than a "top-down" change strategy, unlike the strategy observed in many other change processes), it is concluded that the introduction of computer technology is likely to be successful. (GL)

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Interactive Technology Laboratory

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Report #2

Computers in Education
The Process of Change

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March, 1984

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ABSTRACT

There are serious problems in our American educational system. Microcomputers in education are seen by many as a means to address these problems. This report looks at the process of change in the American school system with the introduction of microcomputers. It shows how microcomputers are effecting change in four schools in San Diego County. There are indications that computer technology will not go the path of previous innovations. The change process of computers in education is significantly different than other attempts at change in the school system. Teachers, especially the computer experts, are key individuals in this change process. While all non-computer user teachers are not involved, there seems little resistance to introducing microcomputers in education. And, Different groups throughout the school system are beginning to take part in this process.

INTRODUCTION

There are serious problems in our American educational system. Test scores have been falling. There is wide spread dissatisfaction with the performance of high school graduates. And, there is a concern about the relevance of much of the instructional content for today's changing work environment (NCEE, 1983). Many people see the introduction of microcomputers in education as a means to address these problems.

Most previous attempts to create change by introducing new technology or curricula have met with limited success. Will computer technology follow this same path? Or is the process of the introduction of microcomputers sufficiently different so that it will create significant changes in education?

Studies have been conducted examining what elements are necessary for successful change in schools. Sarason (1982), describes these elements as: positive conceptualization of the change, involvement by those effected by the change, and the development of constituencies. This study will examine whether or not the process of introducing microcomputers in education includes these necessary elements for successful change.

THE INTRODUCTION OF MICROCOMPUTERS IN EDUCATION

Microcomputers have been introduced to schools in a different manner than previous innovations, such as educational TV, new math, or open

classrooms. It has been more of a grassroots phenomenon (Sheingold, 1981) than a "top-down" innovation. This study traces this grassroots phenomenon in four schools in San Diego County, California (2 elementary, 1 middle school, and 1 high school). Four teachers from each school were interviewed and observed in their classrooms. To examine whether or not the process of introducing microcomputers in education includes the necessary elements for successful change, I looked at teachers' training on microcomputers, their attitudes about microcomputers in the schools, ways they have integrated microcomputers into classrooms, and conflicts engendered at all levels of the school system.

Four teachers were selected by each school principal according to their computer expertise. The principals were asked to estimate teachers' computer ability and to choose one teacher from each of the following categories: "expert" computer user, "limited knowledge" computer user, "first-year" computer user, and "non-computer" user.

The "expert" in each school had considerable knowledge in the use of microcomputers and implemented some type of computer curriculum for the school. The "limited-knowledge" teacher used microcomputers for a shorter period of time than the "expert" and used microcomputers in less diverse ways. The "first-year" teacher was introducing the microcomputer in the classroom for the first time this year and has just begun to experience the many different ways in which microcomputers can be used. And, the "non-computer" teacher did not know how to use microcomputers and was not intending to use them in the classroom in the near future.

Interviews were conducted based on questions listed in the appendix. Each interview lasted from one-half to two hours depending on the amount of computer expertise of the teacher. Forty-four hours of classroom observations were also held to verify information collected in the interviews over a twelve week period.

DESCRIPTION OF THE FOUR SCHOOLS

The four schools in this study were selected from the group of schools in Cohen's study on exemplary computer use in schools (Cohen, 1983). The selection of schools that had teachers exhibiting a wide range of computer expertise was necessary to look at the process of change in schools. Following is a short description of each school in this study. The pseudonyms used in Cohen's study will also be used here.

"Eucalyptus" Elementary School. One school was an elementary "magnet" school with grades K-6 has an enrollment of approximately 400 students. This school, referred to in Cohen's study as "Eucalyptus", began using microcomputers two years ago in one 3rd-4th-5th grade split classroom. Last year, the school owned one Apple II microcomputer with two disk drives and one MX 80 printer housed in a moveable cart (Cohen, 1983). For the 1983-1984 school year, the school increased its microcomputer hardware to five Apple microcomputers and one VIC 20, and has purchased additional software for the classrooms. Discretionary funds were the main source used for the microcomputer expansion. The school's computer "expert" coordinates one computer classroom and three other teachers with "limited knowledge" and

"first-year" expertise have begun using microcomputers in their classrooms on a limited basis.

Four classrooms were observed at this school: a split 3rd-4th-5th grade class, considered the computer classroom, taught by the school's computer expert; a 5th-6th grade class which has access to the portable Apple computer each day for a two hour period; a 3rd-4th grade class which also has access to the portable Apple computer; and a 4th grade class which does not use a computer.

The selection of students for the computer classroom is based on students' academic standing and requests by parents. Because the enrollment is limited by room size, the teacher must make the final selection. Students may continue to be a part of the computer classroom for more than one year. Ten of the 34 students accepted were continuing in the computer classroom for a second year.

"Ebony" Elementary School. The second elementary school in this study has grades K-6 with an enrollment of 502 students. This is a "computer magnet" school referred to as "Ebony" in Cohen's study. The school has 23 Apple II computers in a computer lab setting. The computer curriculum consists of Logo programming and word processing which was developed by the school's computer expert.

Four teachers were interviewed at this school. The computer expert left for a job at the local Teacher Education and Computer Center just after the the 1983-84 school session began. Another teacher with some knowledge of the

computer program took over as the computer resource person. Two other teachers having little or no computer expertise were also interviewed.

Each class has a scheduled time to use the computer lab. The computer resource teacher who coordinates and instructs all computer classes. Each teacher in the school is learning how to use microcomputers along with his/her students. This way, if funds are not available next year for a computer resource specialist, the teachers will be able to run the computer lab themselves.

"Mahogany" Middle School. The middle school referred to as "Mahogany" in Cohen's study, has an enrollment of just under 1,400 students in grades 6-8. The school district requires all 6th graders to take a computer literacy course. An elective BASIC programming course is available for 7th and 8th grade students. Last year this school had twelve VIC-20 computers and two Apple II computers, located in a lab setting (Cohen, 1983). This year the school has acquired two microcomputers computers through a special giveaway program from Kaypro. The twelve VIC-20 and one Apple II microcomputers are still in the lab setting, and one Apple II is located in the library. The school has also purchased microcomputers for administrative purposes. Last year, the computer expert taught all the computer literacy courses. During the 1983-84 school year, two 6th grade teachers have taken over the computer literacy course for their students. Two teachers are learning how to use the Kaypros and they hope to use them later this year in the typing and journalism classes.

Four classes were observed at this school. Three teachers were observed

with their classes in the computer lab. Two 6th grade teachers are scheduled with the students into the lab and teach the computer literacy course. A third teacher, in the Math department, is considered the schools computer "expert" and teaches the remaining computer literacy and BASIC programming courses. The fourth teacher in this study teaches 7th and 8th grade Math.

"Hemlock" High School. The high school in this study has an enrollment of 1,700 students and is referred to as "Hemlock" in Cohen's study. Last year, this school had thirteen IBM personal computers and one Apple computer located in a lab setting (Cohen, 1983). Twelve of the IBM PC's were purchased with a grant from the state of California School Improvement Project. In addition to the computer lab, several Apple II computers were located in the library and various classrooms in the school.

During the 1983-1984 school year, this school will be setting up a satellite station in the hall of the science wing. This station will have approximately five Apple IIe computers for the science classes to utilize. The academic Business Department has also acquired ten IBM PCs through the state's Regional Occupation Program to set up a word processing class beginning March, 1984. These ten microcomputers will also be used for accounting classes. The schools computer expert is currently teaching five computer literacy or programming classes. A number of science teachers are using Apple II computers to run simulations of science experiments and data analysis for their classes. Two teachers in the Business Department will be using IBM PCs this spring.

Four teachers were interviewed at this school. One teacher conducts the

computer literacy and RATBAS (a version of BASIC programming for the IBM PC) programming classes. A second teaches Biology using an Apple II for simulations integrated with the textbook. The third teacher is the Business Department chairperson and teaches accounting and Spanish. She will be coordinating the accounting and word processing classes on the IBM PCs this spring. The fourth is a Spanish teacher who does not use computers.

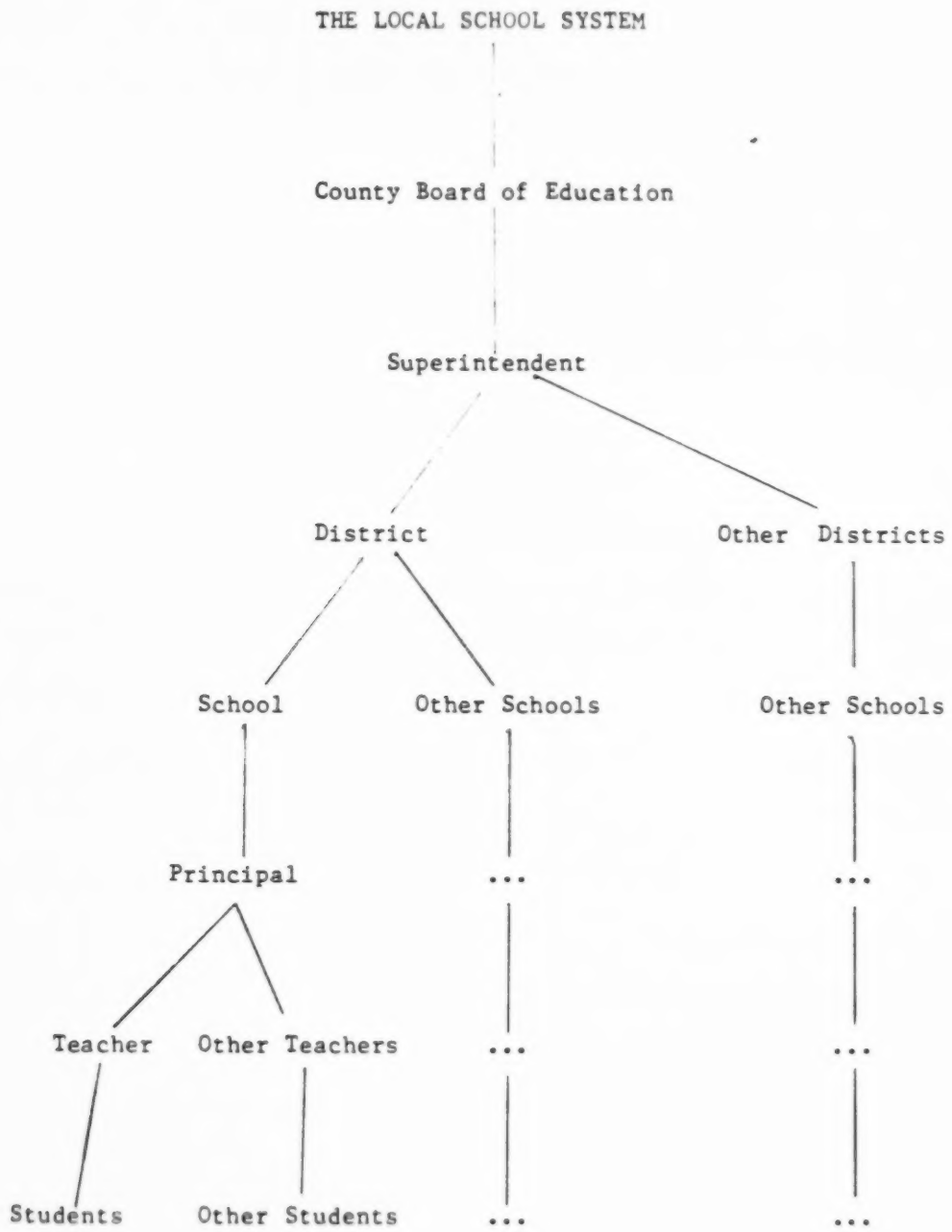
THE AMERICAN SCHOOL SYSTEM

Before discussing the process of change in schools, it is important to understand the American school system. School systems are complex hierarchical institutions which interact with many other systems. Schools are affected by parent groups, universities, state and federal governments, court decisions, and the communities they serve. If the courts did not make decisions on education for the handicapped or desegregation, the school system would certainly teach differently than it does today. If parent groups did not exist, the relationship between teachers and parents would also be different. While it is important to remember this interaction between the school system and groups outside school walls, it is also important to understand the internal structure of the school system.

Like any hierarchical structure, the school system can be defined by its table of organization (Bidwell, 1956). From top to bottom the system consists of boards of education, superintendents, districts, individual schools, principals, teachers, and students. Viewing the internal organization of schools in this way, we see decisions made at the top levels

and carried out at lower levels (see figure 1).

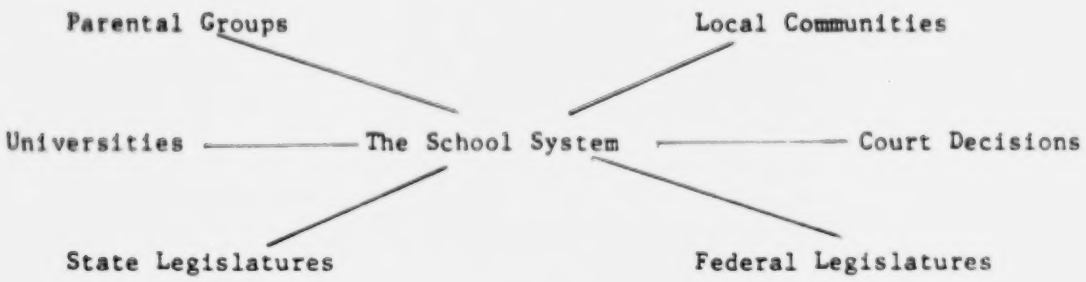
Figure 1:



While understanding the structure of the school system is important, the well known gap between formal and informal organizations (Dalton, 1959) makes it necessary to look at the interactions of students and teachers, teachers and principals, principals and districts, and districts and boards of education to understand the process of change. While a suggested change in the school system may come from any level, the success of the change in the school system is dependent on not only the school system, but also its interaction with parents, communities, universities, legislators, and courts (see figure 2). It is this interaction which causes pressure and conflict between groups as well as makes change possible in the school system.

Figure 2:

OUTSIDE GROUPS INTERACTING WITH THE SCHOOL SYSTEM



ATTEMPTS AT CHANGE IN THE SCHOOL SYSTEM

Sarason, in his studies of the process of change in the school system, points out that a change will be successful if all individuals involved in the change readily accept it (Sarason, 1983). He describes how "new math" failed to become a part of the school system because teachers were not involved in the decision making process. The intended goal was to increase the enjoyment of mathematics for students so that they would continue their higher education in the sciences. When the decision was made to change to "new math", teachers were told they must teach it the following year. They attended workshops and felt pressured knowing that they would have to teach "new math" to their students in several weeks not having mastered the material themselves. The first year was difficult for teachers and supervisors. Eventually, most teachers became comfortable with the material and the students learned "new math", but the intended goal to increase the enjoyment of mathematics for most students was not met. The school system only succeeded in substituting one curriculum for another. Since they disregarded the social relationships among professionals within the school setting, students, and groups outside the school which interact with the system, no major change occurred.

Unlike "new math", microcomputers are beginning to effect change in school systems. How is this change different than the introduction of previous innovations? Does the change process of microcomputers in schools conform to Sarason's theory on the process of change?

MICROCOMPUTERS AND THE CHANGE PROCESS

In order to see how computers in schools have effected change in the school system and compare it to Sarason's theory of the process of change, it is important to look at the conflicts, problems and involvement of teachers during this transition.

Computer use in American schools at present is mostly teacher initiated, but as microcomputer use becomes more widespread school districts have begun to mandate computer instruction (CSOG, 1983). Approximately two years ago, teachers in two of the four schools in this study began writing their own computer curricula. Since then, these curricula have been adopted district-wide. The teachers in the remaining two schools have also written curricula which are being considered as possibilities for district-wide adoption.

THE COMPUTER "EXPERT" EMERGES

The expert teachers in this study have been using microcomputers for instruction for the past few years. These teachers have become computer experts in certain educational applications. They have not only mastered the use of microcomputers for education, but also have been recognized by their local educational community for that knowledge.

The experts in this study learned how to use microcomputers because they had personal interest in microcomputers or considered using microcomputers as a hobby. Each computer expert had his own motivation. There are a variety of

reasons for involvement in microcomputers: one teacher in this study was interested in electronics, another teacher wanted to further his education through a masters program at a local university, and two teachers had friends who used microcomputers, relied on their support and learned how to use microcomputers without formal instruction. Even before microcomputers entered the schools, these teachers were eager to use new technology. One teacher had been using video cameras and monitors as an aid to teaching his students. Another teacher taught high school electronics. Some computer experts in this study began familiarizing themselves with computer technology as long ago as the early 1970's.

One expert began his computer training in a masters program in Educational Technology at San Diego State University in the early 1970's. The remaining experts were self-taught. Most of their information was gained through hundreds of hours of sitting in front of the microcomputer learning from first-hand experience. All these experts talked to parents and university faculty members in the computer field for support. Many of these parents and university faculty members guided teachers in their selection of microcomputer hardware and software for the school and became mentors to the teachers when they came across problems that they could not solve. These experts also relied heavily on software documentation and other teachers who had used the same brand of microcomputer or software. All the computer experts agreed that it took a considerable number of hours to learn how to use a microcomputer.

The amount of time these computer expert teachers spent learning to use microcomputers sets them apart from the other groups of teachers using

microcomputers. The experts spent approximately five or six hours each day for the past few years during off-hours working with computers. As these teachers became proficient in a particular use of the microcomputer, they are asked to sit on committees to develop computer curriculum and to teach classes or workshops on the use of microcomputers in schools.

OTHER COMPUTER TEACHERS EMERGE

After the computer expert introduces microcomputers in the school, other teachers become involved. All but two out of eight limited knowledge and first-year user teachers in this study learned how to use computers primarily by taking classes taught by the computer expert in their school. The limited knowledge teachers' experience with computers varied. They knew BASIC or Logo programming, knew how to use microcomputers to run software simulations for high school biology classes, and knew enough about microcomputers to teach introductory courses in computer literacy. The first-year user teachers' experience consisted of minimal knowledge of programming, no knowledge of microcomputer hardware maintenance, and little to no experience using microcomputers to teach children. All limited knowledge and first-year user teachers also attended at least one course through local adult education classes or the TEC Center, a state funded training center for teachers.

The most important difference between these teachers and the experts is the amount of time these teachers devote to learning how to use microcomputers. The limited knowledge and first-year user teachers spend

approximately five hours each week preparing lessons for computer classes and learning new applications of microcomputers. In comparison, the expert teachers spend an average of five to six hours a day outside of school time working with microcomputers.

Another difference between the teachers is the length of time they have been working with microcomputers. The limited knowledge teachers have used microcomputers for two or more years and the first-year user teachers are currently using or will be using microcomputers in a lab or classroom setting for the first time during the 1983-84 school year. Six out of eight of the limited knowledge and first-year user teachers learned how to use the microcomputer in order to teach classes that were authorized by the school or district. All the limited knowledge and first-year user teachers spend less of their free time learning how to use microcomputers because they have other commitments and interests.

Although there is great enthusiasm for microcomputers in schools, the limited knowledge and first-year user teachers see the microcomputer as a tool for education rather than a hobby or special interest for themselves. These teachers see themselves as teachers first and computer users second.

All first-year users draw heavily upon their school's computer expert for help and their training is largely limited to what the local expert knows. Once the first-year user teachers have limited experience with the microcomputer they begin to generate new ideas and uses for the microcomputer in their classroom. One first-year user took classes in Logo programming, and another used Computer Aided Instruction programs.

However, the major focus of computer instruction is centered on the knowledge of the expert. For example, two experts were teaching BASIC programming in their classrooms and both the first-year users and limited knowledge teachers focused on learning and teaching BASIC programming even though the two limited knowledge teachers had experience in other computer applications.

These limited knowledge and first-year user teachers are not acknowledged by the district or educational community as experts in the computer field. These teachers are not being asked to sit on committees nor are they asked to teach courses to other teachers on how to use microcomputers. The limited knowledge and first-year user teachers experience less conflict than the experts between themselves and the school system.

NON-COMPUTER TEACHERS IN THE SCHOOL

The teachers with no computer experience are not affected by these changes at the present time. Some schools have sponsored computer classes and have opened them to all teachers. In two of the four schools, teachers receive a stipend for attending the classes, but attendance is not mandatory. Two out of four non-computer teachers in this study attended one workshop sponsored by the school, but taking the computer workshop did not change their desire to use microcomputers in the classroom. Some teachers are skeptical about the outcome this new technology will have on education. While the non-computer teachers see microcomputers as a part of

the school curriculum, they are not overly enthusiastic about using microcomputers themselves. When and if computer curriculum is mandated in their school, they will take the necessary courses to learn how to use microcomputers. Until then, they are less likely to become involved.

This may be temporary. Schools currently lack funds for computer hardware and software, as well as funds to train teachers how to use the equipment. As districts formalize computer curricula and states provide funding for equipment and training, more teachers will be under pressure to learn how to use computers in the classroom.

At this point, there are three classifications for teachers using microcomputers. The expert is the teacher who is self-taught, is recognized by the educational community for his knowledge, coordinates the school's computer curriculum, and spends a considerable number of hours using microcomputers both in and out of school. The limited knowledge and first-year user teachers are taught by the expert, spend considerably less time using microcomputers, are continuing to learn more about microcomputers in education, see microcomputers as a tool for education, and see themselves as teachers first and computer users second. The non-computer teachers are acknowledging the existence of microcomputers in the school and at the present time are not involved in computer instruction.

CONFLICTS IN THE CLASSROOM

Teachers who bring microcomputers into the classroom must coordinate computer instruction with their regular teaching schedule. An examination of what happens in the classroom will show both teachers and students adjusting to this change.

Teachers must deal with issues of what to teach and how to present materials. They are faced with a number of problems when microcomputers are in their classrooms. These problems are different than problems occurring in classrooms having no microcomputer. How these problems are addressed today will effect the use of microcomputers in schools tomorrow.

When microcomputers are introduced in the classroom, students are very excited about using them. The students show their enthusiasm by spending time during lunch, working on computer assignments before and after school, or by joining local computer clubs. Since schools have limited numbers of microcomputers in classrooms or computer labs, teachers must schedule computer time. All teachers in this study schedule two, often three students at a microcomputer at the same time in both classroom and computer lab settings.

A few teachers report problems when more than one student at a time uses the microcomputer. When two students sit in front of a microcomputer, one student can dominate its use. For example, two students were writing a program in BASIC which included a number of mathematical calculations to find out a person's age from their shoe size. The student who sat directly in

front of the computer followed the flowchart he had written, and typed in a program. When an error was detected, this student tried to correct the error. The second student sat off to the side and was distracted by other students. When the students were asked to explain the program, the child sitting off to the side was unable to explain the program, while the child who had the hands-on experience explained the program, including what happened in each step of the program. One teacher is trying to prevent this problem by requiring each child to submit his or her own flowchart and program rather than handing in a group project.

Another problem that can arise when students work in pairs is the significant increase in noise in the classroom or computer lab. Since joint problem-solving is encouraged, students will talk to one another while sitting at the microcomputer. As the students encounter errors in their programs, their excitement and frustration increases and they begin to talk louder. While the noise level increases in both classroom and lab settings, it is most noticeable in computer labs with ten or more microcomputers and 20 to 30 students.

Teachers working in a lab setting must continually remind students to talk in a whisper and raise their hands if they have a question. The teachers in this study who use microcomputers in their classrooms have tried to solve the noise problem in a number of ways. One teacher has the microcomputer in a room adjacent to the classroom, another teacher has placed the microcomputer just outside the classroom door, and other teachers have students work at satellite work stations located in the school hall or library.

While some teachers express their concern about problems that arise when students work in pairs, all of the teachers mentioned seeing positive outcomes. Students working in pairs engage in joint problem-solving. Many problems encountered are solved by interaction between the students so the teacher is called on only after the students have exhausted their ideas on how to solve the problem. For example, two students were writing a program which asks the person at the computer to type in their name. When the program did not run properly, the students discussed the problem and tried a number of solutions before calling for help.

In addition to problem-solving, students with more knowledge of microcomputers are assigned to be "computer aides." These students help others when problems arise. Instead of the teacher being overwhelmed with a number of problems at one time, the "computer aide" can help answer student's questions. For example, in one lab six out of 15 pairs of students had questions concerning the program they were writing. With the help of the student aide, their questions were all handled within a few minutes.

Teachers in three of the four schools said they lacked adequate amounts of microcomputer hardware and software. One school which had the fewest number of microcomputers used them in classroom settings, while the other three schools, which all have ten or more microcomputers, have them set up in computer labs. Two computer labs have ten to 15 microcomputers with approximately 30 students in each class. If a microcomputer should break down, three students must work together.

The elementary teachers who have access to fewer microcomputers said they preferred microcomputers in the classroom setting because younger children feel more secure in their own classroom. In one school, four teachers were interested in using a microcomputer in their classroom. There were five microcomputer in the school, but only one was available for three teachers. Each teacher was able to schedule the microcomputer for a two hour period each day. This microcomputer was set up on a moveable cart. While care was taken to move the equipment, there were more microcomputer breakdowns than in schools where the microcomputers were stationery.

The teachers in this study expressed concern about equal access to the microcomputers. In two schools where the students can choose elective computer classes, more boys than girls enrolled in the classes. In another school, most of the time was taken up by mandatory sixth grade computer literacy classes. In a third school, the teacher coordinating the computer magnet program chose the students who would participate in his class.

Lack of computer equipment may also contribute to this equity issue. When computers were first brought into schools, one or two teachers used them in special programs set up for gifted and talented students or for the educationally handicapped students. As schools came under pressure from parents and the community to allow all students access to computers, they received more equipment and more students enrolled in computer classes. However, in the first few years very few girls enrolled in these classes. Some schools are trying to solve this problem by opening enrollment to 50% girls and 50% boys or hand-picking a mixture of students for a magnet program.

A school lacking adequate software will experience slightly different problems. One school does not have software for their Commodore microcomputers so the teachers are limited to teaching BASIC programming. Another school does not have funds to purchase additional software so the students are not being exposed to certain simulations that the teacher thinks would be beneficial.

There is a difference of opinion on whether microcomputer instruction is best handled in a classroom or a computer lab. The teachers who have access to more equipment favor microcomputers in a lab setting. Reasons for favoring lab settings differ between the teachers who are microcomputer users and those who are non-computer users. The non-computer user teachers favor computer lab settings so that their students may learn how to use microcomputers without the teachers having to learn. They feel comfortable about the introduction of microcomputers in the schools but are in favor of having computer teachers teach computer related courses. The non-computer user then is under no pressure or obligation to learn something new in a short period of time. Two of the four non-computer teachers have begun using microcomputers since the initial interviews took place.

Most of the teachers who use microcomputers favor the lab settings, but for other reasons. They are in general agreement that it is beneficial for the students when the entire class works at the microcomputers at the same time. This allows teachers to devote their time to helping students with problems without being interrupted from other classroom activities. It allows problem-solving in groups without disturbing other students. Students who

attend classes in computer labs generally have access to the computer for longer periods of time each week, approximately one hour each day. Also, adult and student aides are more common in a computer lab setting than in an individual classroom using microcomputers.

Typically, teachers with one microcomputer in a classroom with 30 students have to find creative ways to schedule each student so that they all have equal access. Students in two classrooms take turns at the microcomputer in half-hour segments, in alphabetical order by name, or according to student ID numbers. Another teacher schedules one student who has familiarity with the microcomputer with a novice computer user observing the other student. After 30 minutes, the student with more knowledge leaves, and the novice computer user does his/her assignment on the microcomputer while another novice computer user observes. This series continues until all students have had a chance to do their assignment. Students with microcomputers in their classrooms have shorter segments of time than students in a lab setting.

Students working in a computer lab setting pick partners at the beginning of the school year or semester and work together throughout the year. Those students attending classes in computer lab settings have from one to five hours a week of hands-on experience.

Teachers who use microcomputers rely heavily on supplementary handouts for teaching students programming or computer applications. These handouts are usually written by the teacher and explain the sequence of problems that the student is required to solve at the computer. While textbooks are used by students to follow other subjects, textbooks were not available for students

on computer instruction. Teachers have been searching for adequate computer material. Some elementary and secondary teachers recommend the Brown series "Creative Computing" (Brown), McWilliams' books titled "The Word Processing Book" and "The Personal Computer Book" (McWilliams, 1983) and Leuhrmann and Peckham's book titled "Computer Literacy: A Hands-On Approach (Leuhrmann & Peckham, 1983). Although some teachers have found these to be good reference books, none of the schools in this study have purchased books for students. At the present time, teachers are writing their own handouts or drawing upon educational computer magazines like "Electronic Learning" for ideas on how to present computer information to students.

Because teachers have the authority to write whatever workbooks or handouts are necessary for the computer classes, there is an inconsistency in computer curriculum among classrooms in a school and among the schools in a district. Computers in classrooms are used in a variety of ways: some teachers may teach programming, others teach word processing, run Computer Aided Instruction programs, or simulations on particular subjects. By contrast, computer instruction in a lab setting usually focuses on programming and computer literacy.

In a typical school, one teacher may know how to program in BASIC, while another teacher may know how to use a word processor. Without consistency in computer curriculum, a student's knowledge of computers is dependent on their teacher's knowledge of computers. In one school in this study, a fourth-grader learned BASIC programming while a fourth-grader in another classroom used a variety of software.

Besides inconsistency, there can easily be overlap of computer instruction. One school in this study offers a computer literacy course consisting of programming, word processing, and computer history and also offers introductory courses in programming and word processing. Although one class may be organized as a prerequisite to the other, no prerequisites are currently established and the programming and word processing classes cover some of the same material that is also covered in the computer literacy class.

Inconsistency and overlap appears between schools in the same district. In one district, a teacher composed a workbook for computer instruction in his school and all teachers in that school followed the workbook, while a teacher in another school in the district taught something different. These inconsistencies make it difficult for school districts to write computer curricula and to evaluate what students should learn at different grade levels. Some students will have redundant computer instruction and others will have less computer instruction than the district has mandated. district or county. One school in this study requires its students to take a computer literacy course consisting of programming, word processing, computer history, and other computer applications. Another school in the same county offers a computer literacy course consisting of programming alone.

Although a number of school districts have developed their own scope and sequence for schools, many districts are looking to conform with other more successful plans. Bitter (1983) has developed a scope and sequence in computer literacy for grades K - 12. This includes familiarization with computers as well as Logo programming in 2nd and 3rd grade, BASIC programming

in grades 4 through 9, and Pascal programming in grades 10 through 12. Although some teachers in this study disagree with this format, three of the school districts in this study are using this as a model by writing scope and sequence which follow Bitter's plan.

Regardless of the programming language or application taught on the microcomputer, the teachers in this study all commented on the importance of learning typing skills. Familiarity with the keyboard is essential to lessening the anxiety felt by students who have a limited amount of time in which to complete their assignment. Nine of the 16 teachers in the study said that without proper keyboarding skills, students hunt-and-peck at the keys. Students are being exposed to "keyboarding" in elementary schools and two schools have software to teach typing. However, formal instruction of touch typing is not introduced until the middle or high school.

While conflicts arise in the classroom concerning equity, noise, lack of equipment, scheduling, lack of computer textbooks, and inconsistencies in computer curricula, teachers are addressing and solving these problems. But teachers and students are not the only people effected by computers in schools. Let us examine the interactions between individuals at different levels in the school system. Their interaction can lead to success or failure at incorporating change in the school system.

CONFLICTS BETWEEN GROUPS IN THE SCHOOL SYSTEM

Among all teachers in this study, it was the group of experts who

experienced the most conflict with different groups throughout the educational system. Conflict appears between the expert and other teachers, principals, and districts. The conflict arises for a variety of reasons and helps to create change in the school system.

While there was not much friction between the experts and other teachers in the schools, there were differences of opinion on the content of computer classes. One expert was teaching BASIC programming and other teachers in the school thought that word processing, simulations, and data base management should also be taught.

In each school there was less interaction between the expert and other teachers during the lunch period and before or after school. The experts frequently ate lunch in their classrooms enabling them to work on the microcomputer or supervise students. The experts often open the computer lab or classroom before or after school hours for student use. The experts also supervise computer clubs before or after school. This separation from their colleagues makes it difficult for other teachers to discuss computer related issues with the experts. However, other teachers are supportive of the experts in their struggle to gain the acceptance of microcomputers in schools.

Prior to a mandated computer curricula changes by a district in the school system, each teacher can use microcomputers in whatever way he/she wants. When the experts in this study began learning about computers, they learned what they wanted to learn, such as a particular programming language, and taught the same materials to other teachers in their schools. This meant

that an expert teacher from one school who knew BASIC programming taught the other teachers in his/her school BASIC programming, while the expert teacher in another school who knew Logo programming taught teachers in the his school Logo programming. There has been no consistency between computer courses at different schools. This may change when districts begin to make central decisions about computer education. Even when district personnel outline computer instruction, other districts are outlining different computer curriculum. At the present time, there are no state or federal laws regulating computer instruction in education.

Districts which have established policies of uniformity in other curricula areas may try to establish regulations on what should be taught in computer classrooms. One district mandated a computer literacy course for all sixth-graders. The district also adopted an elective class in BASIC programming for all middle schools when one teacher submitted a proposal for the course to be taught at his school.

In all four schools, the expert has the responsibility for purchasing and/or maintaining hardware and software, as well as writing curriculum for the computer program. This requires many hours of the expert's personal time. The computer frequently absorbs the expert's time outside the classroom precluding all other personal activities.

While the expert has the responsibility for purchasing microcomputer hardware and software, he has little to no control over the source of funds. Principals often provide the experts with funds to purchase hardware and software and in some cases parent groups may sponsor a fund-raiser for the

school's computer program. Two principals allocated discretionary or special funds for hardware and software purchases. The other principals helped to coordinate special funding for microcomputer acquisition. One computer lab was set up with funds from the Emergency School Assistance Act. Another school set up a computer lab from the School Improvement Project funds and a word processing lab will begin in February, 1984 with funds from the state's Regional Occupation Program.

Conflicts arose between some teachers and principals in this study when the principals ask the teachers to take on additional responsibilities. However, the principals and school administrators play a key role in the development of computer use in schools. Principals have been under pressure from parents and the community to integrate computer curriculum in the schools. With the help of the computer expert, principals have organized workshops on microcomputers for teachers in their schools. Experts are paid to teach the classes and teachers receive stipends for attending. Many principals and administrators have supported teachers who want to take workshops at teacher training centers by allowing release time and providing substitute teachers for the classroom. Principals have also become an intermediary between teachers and districts. In two schools the principal has attended district committee meetings to discuss computer curriculum and funding.

Conflict also appears between the expert and district personnel. Disagreements occur on what computer instruction should be taught in the schools. The expert teachers have been using microcomputers in their classrooms and labs for a number of years, while the districts have only

recently become involved in the decision-making process concerning computer instruction. This difference in definition of the direction of computer education causes conflict because the expert is more knowledgeable about microcomputers than district personnel, yet district personnel have the authority to establish district-wide policy for all schools. District policies may or may not coincide with the "expert's" idea of what should be taught in the classroom.

Dissension may arise even when teachers are instrumental in district decision-making. Three districts in this study have asked the expert teachers to sit on committees to decide district-wide computer curricula. As positive as this may be for the expert and district, two experts were not compensated for their time and effort. The experts began to feel exploited. One computer expert in this study was asked to sit on a committee to set up computer programs for the elementary schools in his district. Prior to becoming involved in the project, this teacher was the computer resource person for the school. He also ran the computer club before normal school hours, and taught evening computer classes to adults four nights a week. This led to an overload of work for the expert and discontent with the school system.

The primary responsibility of the computer expert in each school is to teach computer related courses. The expert begins to view himself differently since he receives recognition for his achievements from the entire educational community. The expert is recognized as a person with more knowledge about microcomputers and is often asked to teach classes to other teachers and to take part in committees which decide computer curriculum for the district.

This, however, can encourage the expert to seek employment outside the school, since careers in computer science receive high pay than careers in teaching. One teacher in this study has already left the teaching profession. This expert was well known among the educational community as an expert in microcomputer hardware and was also considered an expert in Logo programming. He felt stagnant in his position at the school and was at the top of the pay scale, so could not receive any further advancements. He is currently working for the local TEC Center where he receives acknowledgement for his achievements and continues to learn more about microcomputers and their applications. He is also in a position where he may advance his career in microcomputer use in education.

Computer experts recognize their new skills and begin to market these skills outside their regular teaching position. Each expert in this study has been asked to teach other teachers, organize classes at local computer stores, and teach adult education classes at local high schools or community colleges. When asked why they take on this extra work the largest response was monetary reasons.

A time goes on, a new conflict develops: these teachers feel stagnant. They are giving all they can and have little or no time to increase their knowledge. They see themselves, through they eyes of the educational community, as an expert in computer use in education. They are then faced with the decision to leave the teaching profession for a professional position which may pay more money, increase their personal knowledge of computers, or acknowledge their expertise in microcomputer use in education.

Local TEC Centers are beginning to recognize this problem and are trying to keep these teachers in education by planning to offer classes to the experts to increase their knowledge so that they will not feel a lack of personal growth. Currently, three of the four experts in this study are working with the TEC Center to teach classes in microcomputers uses in education and to organize a computer bulletin board. The fourth expert is teaching adult education microcomputer classes four nights a week.

Conflicts may also appear when the districts are not yet involved in implementing microcomputer instruction in the schools. One school in this study is in a difficult position at this time. A magnet computer program was established two years ago and the funds run out in June, 1984. Since the teachers who are in the school do not have sufficient knowledge to allow the computer lab to be run independently, a computer resource teacher is still needed. Funds for the program will soon be exhausted and funding alternatives are under consideration. The school hopes that the district and school site council will acknowledge the need for a resource teacher and that special funds will be allocated from the district. This is the only computer magnet school in the district and the success of this program will affect the outcome of other schools in the district adopting similar computer programs.

Conflicts occur in the school system among the different groups, however, they are gradually working out their differences. The experts are beginning to receive more recognition for their knowledge and are beginning to receive compensation for their efforts. Principals are supporting

teachers by providing funds for the expansion of computer programs. They are also acting as liaisons between teachers and districts, the expert and other teachers, and the school and community. Districts are considering uniformity of computer instruction in the schools. And the TEC Centers are trying to provide computer education for teachers with a variety of experiences.

Now that we have seen how the school system is adapting to the change process, let us take a closer look at the interaction of the school system with outside groups. Groups outside the school system are offering technical support to teachers using computers. These groups are parents, nonprofit organizations, universities, businesses, and legislatures at the state and federal level.

OUTSIDE GROUPS INTERACTING WITH THE SCHOOL SYSTEM

Parental and Community Involvement in the School System. Parent groups influence schools to use microcomputers. Throughout the county, parents are purchasing computer systems for the home. This leads to parental pressure on the schools to purchase computers. Parents and local Parent Teacher Associations (PTA's) also play an important role in school decision-making. Some schools acquire their first microcomputers through donations and fund raising drives sponsored by PTA's (CSOS). Some parents have made a personal commitment to schools by volunteering their time to assist teachers in computer classrooms. Parents protested when schools began their computer programs and computer access was limited to "gifted" or "remedial" students. As more computer hardware and software was acquired, all students had the

opportunity to use the microcomputers. Some schools have noticed less parental involvement once computer curriculum and equal access to computers is established.

The local community also plays a role in decision-making for school curriculum. Committees are formed at the district level to discuss possible changes in curriculum. These committees are formed from school personnel, district personnel, people in business, and members of the community. For computer curriculum changes, a committee will discuss microcomputer hardware and software availability, funding needed to implement the change, possible sources of funding, uses of computers, and review of the proposed outline course of study.

Non-profit Organizations Support Teachers. In San Diego county, both computer experts and non-experts belong to the San Diego Computer User Educators (SDCUE) which is a local affiliate of the national organization of Computer User Educators (CUE). SDCUE has over 600 members and the national organization has approximately 7,000 members. This group consists of elementary, middle, and high school teachers, university professors, and professional business people joined together for the purpose of increasing the awareness and use of computers in the classroom.

Monthly meetings are held at which two or three guest speakers discuss issues related to computer use in schools. Time is set aside for members to discuss problems that arise and to learn new ways to integrate computer activities in the classrooms. Within the organization, individuals form special interest groups (SIGs) to discuss individual interests. These SIGs

meet at least once a month in various locations throughout the county to discuss issues in depth. Also, computer conferences are co-sponsored by CUE and by local affiliates bi-annually to inform the educational community of state-of-the-art microcomputer uses for education.

Universities Provide Technical Training and Support. University and adult education courses are being organized to train teachers how to use microcomputers, how to integrate a microcomputer in the classroom, and how to program in Logo, BASIC, and Pascal. Adult education courses sponsored through local colleges are available throughout the year. For more formal accredited instruction, some universities offer masters programs in Educational Technology specifically designed for teachers who want to learn how to use computers. These programs include the history of computers, familiarity with computer hardware, and modifying or writing programs. There is a fee for these courses and programs, and the individual teacher incurs the expense.

Other universities support the school system by conducting research projects in schools using microcomputers. For example, at the University of California, San Diego, there have been several research projects funded by state, federal, or private agencies that have involved teachers and students in elementary schools (Levin, 1981; Cole, 1982; Mehan, 1983). Researchers provide support to teachers and schools. Research projects often provide microcomputers and software for the schools in the study allowing educators to experiment with different microcomputers and a variety of software prior to making a large financial investment. Researchers provide technical training for teachers who will be using the microcomputer. They also provide suggestions on ways microcomputers can be used as tools for learning.

The Role of the Teacher Education and Computer Centers. The state of California also provides similar training for the teachers in this study through the Teacher Education and Computer Centers. Fifteen TEC Centers have been established throughout California under the Hughes-Hart Educational Reform Act of 1983 (Senate Bill 813). The purpose of the TEC Centers has been to provide for staff development in teaching methodology, resource brokerage and capacity building, and computer use. To provide teacher training in computer use, the TEC Centers in San Diego and Imperial counties have set up computer demonstration labs, created a network of computer specialists to help teachers, advise schools and districts on microcomputer hardware and software acquisition, and provide training to teachers on computer use and educational technologies. A microcomputer center has been set up where teachers may work with on a number of different brands of computers or may review software. There is a software library which contains approximately 600 programs for preview on the Apple, IBM, Atari, TRS-80, and Commodore microcomputers and a variety of computer magazines.

The Role of Business in Education. Businesses are also playing an active role in school computer programs. The adopt-a-school program joins businesses and schools together to help students understand the business world. One school in this study has been adopted by a computer firm in the area. The company provides tours for the high school students to see how a business operates. They also provide guest speakers for the school and donate surplus equipment. Software developers are focusing on educational needs and are writing educational programs for a variety of subjects. And, computer retailers demonstrate computer hardware and educational software at schools

and educational conferences.

The Educational Testing Service and College Placement. The Educational Testing Service which coordinates the college entrance examinations has also become involved in computer instruction in schools by establishing an advanced placement test in Computer Science. The ETS has suggested that high schools throughout the country offer an Advanced Placement Computer Science course. While this course would be comparable to a first-year course in computer science at a college or university, it is intended to serve both the college-bound students majoring in computer science and students who will major in other disciplines that require significant involvement with computers. The Advanced Placement Computer Science course includes: programming methodology, features of programming languages, data types and structures, algorithms, applications of computing, computer systems, and social implications. The ETS has chosen Pascal as the programming language to be taught in this course.

State and Federal Government Involvement in Education. The grassroots phenomenon which started in the classroom is beginning to have an effect on state government. Two states which have taken action on computer use in schools are California and Minnesota.

California legislators passed bill HR5573 proposed by Representative Stark, commonly known as the "Apple Bill". During the 1983-84 school year, schools are receiving free microcomputers from Apple, Kaypro, and Hewlett Packard Companies. This bill sets up a tax credit for industries participating in this "giveaway" program. A bill similar to the California

"Apple Bill" was proposed by the federal government, but to date, has not passed.

In September, 1983, the Governor approved California Assembly Bill 803 known as the Educational Technology Local Assistance Program. This bill authorizes various types of grants for school districts, county offices of education, public postsecondary educational institutions, individual teachers, and TEC centers, and sponsors regional occupation programs. This bill also authorizes research and development of educational software and will award a contract for the production of a television-based learning system pertaining to computers. More than $5,000,000 was appropriated for a five year period. Five hundred thousand dollars was appropriated for the 1983-84 fiscal year. Two hundred thousand dollars will be used for research and exemplary use studies, and $300,000 will be used for state operations grants. Appropriations for the 1984-85 budget will be decided in July, 1984.

Minnesota legislators have passed similar legislation. In 1973, the Minnesota Educational Computing Consortium (MECC) was created to coordinate the implementation of computer programs in the state. The state purchased 4,000 microcomputers between 1978 and 1981 and also has a timesharing computer which enables 1,200 terminals across the state to access a large mainframe computer. Every student is currently receiving some form of computer instruction (MECC, 1980). The state has mandated schools utilize technology which includes microcomputers and videodiscs. They recently allocated over five million dollars to fund staff training, develop plans, and purchase high quality software. Minnesota legislators are currently pushing for consistency in computer education by requiring schools to

purchase software from a list that has been approved by the State (InfoWorld Vol. 5, Issue 49, p. 46). This is similar to the way states authorize which textbooks schools may purchase. In this sense, states are beginning to recognize the change and coordinate the use of microcomputers in schools.

Federal legislators are also concerned about new technology in the schools. In March, 1983, the House of Representatives of the United States sent bill HR 1310 to the Senate for approval. This bill, known as the Emergency Mathematics and Science Education and Jobs Act, will provide funds to improve elementary, secondary, and postsecondary education in mathematics and science; to provide a national policy for engineering, technical, and scientific personnel; to provide cost sharing by the private sector in training such personnel; and to encourage creation of new engineering, technical, and scientific jobs. If passed, this bill will allocate $250,000,000 to the Department of Education for improving mathematics and science education in 1984 plus an unspecified amount for 1985.

Together, these groups are providing funds, training, information, and support to further the growth of computer use in education. What began as a grassroot phenomenon has spread to all levels of the school system and has involved different groups outside the schools which directly or inIirectly effect the course of education.

A COMMENTARY ON THE SUCCESSFUL IMPLEMENTATION OF CHANGE

Will computer technology follow the same path of previous attempts at educational innovations, and lead to little or no known effect on schools? Or is the process by which computers are being introduced into schools sufficiently different so that it will create significant changes in education? Does this change process of microcomputers in schools conform to Sarason's theory on the process of change?

There are certain factors that lead to effective change in schools. Sarason (1982) discusses three important points. First, it is important to see how the change process is conceptualized by the educators involved. Second, it is equally important to involve those directly or indirectly affected by the change. And lastly, it is important to develop constituencies as a means of sustaining change after the funding for initial efforts has diminished.

Conceptualization of Change. Educators are reacting positively to microcomputers in schools. This grassroots phenomenon began when teachers brought computers into their classrooms. First, computer experts were the only ones using computers. Then teachers less skilled on computers joined in. These teachers have support from the experts who are willing to answer questions and conduct workshops. While there are teachers who do not use computers, they have not resisted the introduction of computers into schools since they presently are not required to use computers themselves. The

teachers are finding new enthusiasm in the teaching profession when microcomputers are used. Principals are playing an active role in teacher training and funds acquisition. Districts are beginning to establish policies affecting computer education in schools and the experts are playing an active role in the decision-making process for district wide curricula changes. Groups outside the school system are providing technical and financial support for computer use in education.

Involvement of Those Affected by Change. Educators throughout the school system are involved in this change. In this study, we have seen teachers developing their own method of computer instruction. Prior to school districts involvement in computer curricula, teachers set their own goals. This way, they have a clear understanding of what they will do with microcomputers in their classrooms. Teachers are discussing their implementation strategies with other teachers, principals, school districts, and business professionals. Since teachers are using computers prior to mandated change, they have the time to address conflicts encountered in the classroom, school, and district before going on to more complex issues. They are seeking their own computer training and at the present time are not limited to one specific path of computer instruction. Workshops are offered giving specific training on how to use a microcomputer in the classroom. Non-profit organizations and people in industry are helping teachers think about how computers can be used in schools. And, districts are slowly establishing policies affecting computer education in schools.

Development of Constituencies. Constituencies are being developed as a means to survival in the coming years. We must keep in mind that computers

were introduced into schools before federal or state funding. Even now, funding focuses on the development of a program or on tax-credits for businesses assisting schools in their computer program developments. Federal or state legislatures have not mandated computer instruction and the current legislation does not call for mandatory computer use in the near future.

In short, there are indications that computer technology will not go the path of previous innovations. The change process of computers in education is significantly different than other attempts at change in the school system which have not been successful. Teachers, especially the computer experts, are key individuals in this change process. While all non-computer user teachers are not involved, there seems little resistance to introducing microcomputers in education. And, different groups throughout the school system are beginning to take part in this process. ^p3

CONCLUSION

What can we expect in the future? This study has shown that the necessary factors for computers to implement successful change in schools are present. There is a positive reaction by educators toward computer instruction in schools. Those directly and indirectly involved in computer instruction are a part of the decision-making process. And, constituencies are developing to support computer education. What remains to be seen is how this change will continue in the long run.

If the goal of computer education is to better prepare students for

tomorrow's work force, the districts should consider the needs of industry. Programming and basic skills instruction are currently the main computer use in San Diego County schools (CUSG; 1983) and schools across the nation (CSOS; 1983). However, a programming language such as BASIC does not have business applications. Schools teaching computer applications such as word processing, spread sheet analysis, and database management will better prepare students for jobs.

At present, all teachers are not expected to become "computer experts" in this vast, new, ever changing field. To try to do so would be unrealistic since even the experts are finding it difficult to be knowledgeable in a variety of computer uses. A gradual introduction to computer technology and instruction for those teachers who are willing and excited about this technology will go a long way to sustaining the change successfully.

Educators involved in decision-making should keep in mind that microcomputers are not a panacea for improving education. More research needs to be conducted to determine the effects of computer instruction on education. As more schools acquire funds for computer hardware and software purchases, newer and more sophisticated equipment will become available to schools. This new equipment might lend itself to more sophisticated special purpose programming languages and applications not in existence today. This will put pressure on districts to continually revise existing computer curricula. Computer technology is changing so rapidly that it is difficult to say where it will lead, but, from its beginning, the American school system should experience successful change in the future.

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APPENDIX

Interview Questions for Teachers Using Computers

Level 1 - computer "expert"
Level 2 - "limited knowledge" of computers
Level 3 - "first year" computer user

TEACHER TRAINING

How many years have you been teaching?
How many years or months have you been learning about computers?
How many years have you been teaching computers?
What types of computers do you know how to operate?
How did you learn how to use computers?
Since last September, how much time did you spend outside the classroom attending workshops and classes?
How much time was spent in these workshops and classes (1 or 2 hours or all day)?
Have these workshops and classes affected your enthusiasm in placing a computer in your classroom?
Why?
What other types of training have you had on the computer?
What knowledge gained from this training did you take back to the classroom?
Did you teach yourself how to use the computer?
Do you teach yourself how to use the software?
What sources of information did you use (textbooks, documentation)?
Do you help other teachers in your school or district with computer use and curriculum for their classrooms?
What types of help do they need most?
Are you involved in a computer network?
If yes, is it an effective way to solve problems encountered in the classroom?
What type of workshops would you attend if they were available?

ATTITUDES

What were your initial reactions to computers in the classroom?
What are your present attitudes toward computers in the classroom?
Do you think computer training is best handled in resource labs by a few teachers or in each classroom by all teachers to teach some level of computer instruction?
Why?
What types of computer instruction do you think are most helpful to the children in your grade level?
The Educational Testing Service (ETS) has an advanced placement for college entrance for Computer Science which includes the subject of Pascal programming.
What impact will this have on your school (HS)?
In what ways is the current computer curriculum in your class preparing students for either college entrance or employment opportunities after graduation (HS)?

Are you compensated for any outside computer work (teacher training, computer clubs, attending workshops)?
How do you feel about that?
Does your principal and district support what you are doing?
Are you a member of a computer interest group?
(CUE, Apple Core, Greater San Diego Math Council) If yes, what is your involvement?
Are you a member of a teacher organization?
If so, which?

PROBLEMS

How do you find out about good software?
Do you have a chance to try the software before you buy it?
Who buys software for your classroom?
Where do you go for help with computer hardware and software problems?
What printed material do you refer to for additional support ?
On a scale from extremely helpful to not helpful, how would you rate each of your support sources?
What kinds of problems are you able to solve yourself?
What kinds of problems do you need help solving?
What do you find most frustrating regarding computers in the schools?
Why?

INTEGRATION

In general terms, what do you do to prepare a lesson using computers?
Do you use additional instructional materials (workbooks, quizzes) to help your students learn with the computer?
How do you schedule time on the computer?
How many children work on the computer at the same time (alone, in pairs)?
Over the past week, how much time outside of school was spent preparing lessons for your class?
How do you integrate computer activities into your regular curriculum?
What computer activities have worked well in your classroom?
What programs are being used in your classroom?
Are they coordinated with other classroom activities and lessons?
What was the last computer lesson you presented to the class?
How long did it take you to prepare the lesson?
In detail, describe the preparation for that lesson.
How does the computer instruction taught at your grade level prepare the students for more advanced levels of computer classes taught in the upper grades?
How many teachers in your school use computers in their classroom or resource room?
Do you use computer aides in your classroom?
How many aides do you have?
Are they all volunteers?
Are aides necessary in the classroom when using the computer?
If aides are necessary, what student/aide ratio would you recommend?

Have you come across a good computer textbook that you would recommend to other teachers?
If so, what is the title and who is the author?
Have you come across a good computer guide book that you would recommend to other teachers?
If so, what is the title and who is the author?
What would your suggestion be for a sequence of instruction using computers for elementary, middle, and secondary classes?
How do you decide what you will teach your students about computers?
(ie: is it based on what you like to do with the computer, or is it based on a recommended curriculum)

Interview Questions For Teachers Not Using Computers

Level 4 - non-computer users

TEACHER TRAINING

How many years have you been teaching?
Have you ever used a computer?
If yes, what have you used it for?
Would you like to know more about using computers in the classroom?
How would you use the computer (personal or school use)?
Since a year ago last September, have you spent time outside the classroom attending workshops or classes for school curriculum?
If yes, how many workshops and classes have you attended since a year ago last September?
Were they 1 or 2 hour or all day workshops?
Have you ever attended a computer workshop or class?
If yes, have these workshops and classes affected your enthusiasm in placing a computer in your classroom?
How so?

ATTITUDES

What were your initial reactions to computers in the classroom when you heard they were in your school?
What are your present attitudes toward computers in the classroom?
Do you think computer training is best handled in resource labs by a few teachers or in each classroom by all teachers to teach some level of instruction on the computer?
Why?
The Educational Testing Service (ETS) has an advance placement for college entrance for Computer Science which includes the subject of Pascal Programming.
What impact will this have on your school?
Are you a member of a teacher organization?
If yes, which?
What is your attitude about teachers in your school who have taken an initiative in placing computers in their classroom?

PROBLEMS

What would you find most frustrating if you were told you must

include some form of computer instruction in your classroom?
What other problems do you see if all teachers are asked to include some form of instruction on the computer in their daily curriculum?
How much of your own time would you be willing to spend learning about computers and how to use them in the classroom?
Would you take computer workshops or classes on your own time?

INTEGRATION

In general terms, what do you do to prepare your lessons?
Do you follow a specific plan outlined by the state or school, or are you able to incorporate your own plan for curriculum?
Over the past week, how much time was spent preparing lessons for your class?
What was the last lesson you prepared for your class?
How much time did you spend preparing the lesson?
In detail, describe the preparation for that lesson.
How many teachers in your school use computers in their classroom or resource room?
Do you use aides in your classroom?
If yes, how many do you have?
What activities do they help with?

Observing Classrooms and Resource Rooms

CLASSROOM SPATIAL ORGANIZATION

Draw a map of the physical layout of your classroom.
Show student seating configurations, location of the teacher's desk, learning centers, and available resources (include bulletin boards, posters and what is posted on them in your map and its accompanying description).
Describe the activities that occur in the various areas of the classroom; are there rules for behavior in those work areas?
If so, what are these rules, and how are they taught, reinforced.
Describe the students' arrangements.
Are these arrangements by student choice?

CLASSROOM TEMPORAL ORGANIZATION

Determine the time schedule of daily activities for the time that you are in the classroom.
Record as: Time and Activity
What is the flow of activities from event to event?
How does the teacher get the students from one place to another, from one event to another?
Does the teacher use lesson plans?
Of what kind?
Does the teacher deviate from them?
How much time is spent on each subject taught?
How is computer time scheduled?

BEFORE AND AFTER SCHOOL

Do teachers allow computer use before, at lunch, or after school?
Who has access to the computers at this time?
Why is it set up this way?

CLASSROOM MANAGEMENT

Observe and record the way the teacher manages tasks and integrates managerial tasks with lessons.
Record the ways in which the teacher disciplines children.
Does he or she discipline all children in the same way?
Or, are there differences?
In computer classrooms, is the computer used as a reward for behavior?
Do children ask the teacher for help?
How do they do this?
Are there differences in the ways in which different children ask for help?
How does the teacher respond to the students requests for help?
Is there an aide in the classroom?
Is there an aide for the computer?
What is the student/aide ratio?

<u>The following questions should be answered when observing non-computer classrooms</u>

Is the classroom set up in the traditional way (teacher teaches all students at one time) or is it set up in work groups or stations?
If the classroom is set up in stations, how many stations are there?
What activity goes on in each work station?
How many children are in each work station?
Are there interruptions in the classroom?
What kinds of interruptions are they?
How many interruptions occurred during the time you observed the classroom?
Is there an aide in the classroom?
If yes, what does the aide do?
Does the teacher seem prepared for the lessons and activities?